IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re PATENT APPLICATION OF
TOGINO
Div of Appln. No.: 09/501,320
Filed: January 25, 2002
Title: IMAGE-FORMING OPTICAL SYSTEM

Confirmation No.: Unknown
Group Art Unit: 2872
Examiner: R. Shafer

January 25, 2002

* * * * *

PRELIMINARY AMENDMENT

Hon. Commissioner of Patents
Washington, D.C. 20231

Sir:

Before examination on the merits, please amend the above identified application as follows:

IN THE SPECIFICATION:

Page 1, line 1, please insert the following new paragraph

--CROSS REFERENCE TO RELATED APPLICATION

This application is a divisional of U.S. Application No. 09/501,320, filed February 10, 2000, the specification and drawings of which are incorporated herein by reference.--

See the attached Appendix for the changes made to effect the above paragraph

IN THE CLAIMS:

Please cancel claims 1-5 and 13 without prejudice.

Please enter the following amended claims:

6. (Amended) An image-forming optical system according to claim 25, wherein both said first reflecting surface and said second reflecting surface have a curved surface configuration that gives a power to a light beam, said curved surface configuration being a rotationally asymmetric surface configuration that corrects aberrations due to decentration.

7. (Amended) An image-forming optical system according to claim 25, wherein both said third reflecting surface and said fourth reflecting surface have a curved surface configuration that gives a power to a light beam, said curved surface configuration being a rotationally asymmetric surface configuration that corrects aberrations due to decentration.

8. (Amended) An image-forming optical system according to claim 25, wherein said first entrance surface has a curved surface configuration that gives a power to a light beam, said curved surface configuration being a rotationally asymmetric surface configuration that corrects aberrations due to decentration.

9. (Amended) An image-forming optical system according to claim 25, wherein said first exit surface has a curved surface configuration that gives a power to a light beam, said curved surface configuration being a rotationally asymmetric surface configuration that corrects aberrations due to decentration.

10. (Amended) An image-forming optical system according to any one of claims 6 to 9, wherein the rotationally asymmetric surface configuration of said prism member is a plane-symmetry free-form surface having only one plane of symmetry.

14. (Amended) An image-forming optical system according to claim 25, wherein optical surfaces of said prism member that are closer to an object side than said intermediate image plane are arranged to correct decentration aberrations as a whole and optical surfaces of said prism member that are closer to an image-formation plane side than said intermediate image plane are arranged to correct decentration aberrations as a whole so that said intermediate image plane is formed in an approximately planar shape.

15. (Amended) An image-forming optical system according to claim 25, wherein, when powers in X- and Y-directions of an entire optical system are denoted by Px and Py, respectively, and powers in the X-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Px1-1, Px1-2, Px2-1 and Px2-2, respectively, and further powers in the Y-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Py1-1, Py1-2, Py2-1 and Py2-2, respectively, the following condition is satisfied:

$$0.4<Px1\text{-}1/Px<1.1 \qquad \ldots.(1).$$

16. (Amended) An image-forming optical system according to claim 25, wherein, when powers in X- and Y- directions of an entire optical system are denoted by Px and Py, respectively, and powers in the X-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Px1-1, Pxl-2, Px2-1 and Px2-2, respectively, and further powers in the Y-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Py1-1, Py1-2, Py2-1 and Py2-2, respectively, the following condition is satisfied:

$0.1<Px1\text{-}2/Px<0.6$ ....(2).

17. (Amended) An image-forming optical system according to claim 25, wherein, when powers in X- and Y-directions of an entire optical system are denoted by Px and Py, respectively, and powers in the X-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Px1-1, Px1-2, Px2-1 and~Px2-2, respectively, and further powers in the Y-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface
are denoted by Py1-1, Pyl-2, Py2-1 and Py2-2, respectively, the following condition is satisfied:

$0.2<Px2\text{-}1/Px<1$ ....(3).

18. (Amended) An image-forming optical system according to claim 25, wherein, when powers in X- and Y- directions of an entire optical system are denoted by Px and Py, respectively, and powers in the X-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Pxl-1, Px1-2, Px2-1 and Px2-2, respectively, and further powers in the Y-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Pyl-1, Py1-2., Py2-1 and Py2-2, respectively, the following condition is satisfied:

$0.5<Px2\text{-}1/Py2\text{-}1<2.0$ ....(4).

19. (Amended) A finder optical system comprising:

said image-forming optical system according to claim 25, said image-forming optical system being provided as a finder objective optical system;

an image-erecting optical system for erecting an object image formed by said finder objective optical system; and

an ocular optical system.

20. (Amended) A camera apparatus comprising:

said finder optical system according to claim 19; and

an objective optical system for photography provided in parallel to said finder optical system.

21. (Amended) An image pickup optical system comprising:

said image-forming optical system according to claim 25; and

an image pickup device placed in an image plane formed by said image-forming optical system.

22. (Amended) A camera apparatus comprising:

said image-forming optical system according to claim 25, said image-forming optical system being provided as an objective optical system for photography; and

a finder optical system placed in one of an optical path separate from an optical path of said objective optical system for photography and an optical path split from the optical path of said objective optical system for photography.

23. (Amended) An electronic camera apparatus comprising:

said image-forming optical system according to claim 25;

an image pickup device placed in an image plane formed by said image-forming optical system;

a recording medium for recording image information received by said image pickup device; and

an image display device that receives image information from one of said recording medium and said image pickup device to form an image for observation.

24. (Amended) An endoscope system comprising:

an observation system having said image-forming optical system according to claim 25 and an image transmitting member for transmitting an image formed by said image-forming optical system along a longitudinal axis; and

an illumination system having an illuminating light source and an illuminating light transmitting member for transmitting illuminating light from said illuminating light source along said longitudinal axis.

See the attached Appendix for the changes made to effect the above claim(s)

Please add the following new claim(s):

25. (New) An image-forming optical system having positive refracting power as a whole for forming an object image, said image-forming optical system comprising:

a first prism member formed from a medium having a refractive index (n) larger than 1 (n>1); and

a second prism member formed from a medium having a refractive index (n) larger than 1 (n>1);

said first prism member comprising:

a first entrance surface through which a light beam from an object enters said first prism member;

a first reflecting surface and a second reflecting surface, which reflect said light beam within said first prism member; and

a first prism exit surface through which said light beam exits said first prism member;

said second prism member comprising:

a second prism entrance surface through which the light beam from said first prism member enters said second prism member;

a third reflecting surface and a fourth reflecting surface; and

a first exit surface through which said light beam exits said second prism member;

wherein said first prism exit surface and said second prism entrance surface are positioned to face each other across an air spacing;

wherein said first prism member forms first intersecting optical paths in which an optical path connecting said second reflecting surface and said first prism exit surface intersects an optical path connecting said first entrance surface and said first reflecting surface;

wherein said second prism member forms second intersecting optical paths in which an optical path connecting said second prism entrance surface and said third reflecting surface intersects an optical path connecting said fourth reflecting surface and said first exit surface;

wherein at least one of said first reflecting surface and said second reflecting surface has a curved surface configuration that gives a power to a light beam, said curved surface configuration being a rotationally asymmetric surface configuration that corrects aberrations due to decentration;

wherein at least either one of said third reflecting surface and said fourth reflecting surface has a curved surface configuration that gives a power to a light beam, said curved surface configuration being a rotationally asymmetric surface configuration that corrects aberrations due to decentration; and

wherein said first prism member and said second prism member are arranged to form an intermediate image plane in an optical path between said second reflecting surface and said third reflecting surface.

REMARKS

Consideration and allowance of the present application based on the foregoing amendments are respectfully requested.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached Appendix is captioned **"Version with markings to show changes made"**.

It is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 1, line 1, please insert the following new paragraph

CROSS REFERENCE TO RELATED APPLICATION

This application is a divisional of U.S. Application No. 09/501,320, filed February 10, 2000, the specification and drawings of which are incorporated herein by reference.

IN THE CLAIMS:

Claims 1-5 and 13 have been cancelled herein, claims 6-10 and 14-24 have been amended and new claim 25 has been added.

6. An image-forming optical system according to claim **[1]** 25, wherein both said first reflecting surface and said second reflecting surface have a curved surface configuration that gives a power to a light beam, said curved surface configuration being a rotationally asymmetric surface configuration that corrects aberrations due to decentration.

7. An image-forming optical system according to claim **[1]** 25, wherein both said third reflecting surface and said fourth reflecting surface have a curved surface configuration that gives a power to a light beam, said curved surface configuration being a rotationally asymmetric surface configuration that corrects aberrations due to decentration.

8. An image-forming optical system according to claim **[1]** 25, wherein said first entrance surface has a curved surface configuration that gives a power to a light beam, said curved surface configuration being a rotationally asymmetric surface configuration that corrects aberrations due to decentration.

9. An image-forming optical system according to claim **[1]** 25, wherein said first exit surface has a curved surface configuration that gives a power to a light beam, said curved surface configuration being a rotationally asymmetric surface configuration that corrects aberrations due to decentration.

10. An image-forming optical system according to any one of claims **[1 to 5]** 6 to 9, wherein the rotationally asymmetric surface configuration of said prism member is a plane-symmetry free-form surface having only one plane of symmetry.

14. An image-forming optical system according to claim **[1]** 25, wherein optical surfaces of said prism member that are closer to an object side than said intermediate image plane are arranged to correct decentration aberrations as a whole and optical surfaces of said prism member that are closer to an image-formation plane side than said intermediate image plane are arranged to correct decentration aberrations as a whole so that said intermediate image plane is formed in an approximately planar shape.

15. An image-forming optical system according to claim **[1]** 25, wherein, when powers in X- and Y-directions of an entire optical system are denoted by Px and Py, respectively, and powers in the X-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by

Px1-1, Px1-2, Px2-1 and Px2-2, respectively, and further powers in the Y-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Py1-1, Py1-2, Py2-1 and Py2-2, respectively, the following condition is satisfied:

$$0.4<Px1\text{-}1/Px<1.1 \quad \ldots.(1).$$

16. An image-forming optical system according to claim **[1]** 25, wherein, when powers in X- and Y- directions of an entire optical system are denoted by Px and Py, respectively, and powers in the X-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Px1-1, Pxl-2, Px2-1 and Px2-2, respectively, and further powers in the Y-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Py1-1, Py1-2, Py2-1 and Py2-2, respectively, the following condition is satisfied:

$$0.1<Px1\text{-}2/Px<0.6 \quad \ldots.(2).$$

17. An image-forming optical system according to claim **[1]** 25, wherein, when powers in X- and Y-directions of an entire optical system are denoted by Px and Py, respectively, and powers in the X-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Px1-1, Px1-2, Px2-1 and~Px2-2, respectively, and further powers in the Y-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface

are denoted by Py1-1, Pyl-2, Py2-1 and Py2-2, respectively, the following condition is satisfied:

$0.2<Px2\text{-}1/Px<1$ ....(3).

18. An image-forming optical system according to claim [1] 25, wherein, when powers in X- and Y- directions of an entire optical system are denoted by Px and Py, respectively, and powers in the X-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Pxl-1, Px1-2, Px2-1 and Px2-2, respectively, and further powers in the Y-direction of the first reflecting surface, the second reflecting surface, the third reflecting surface and the fourth reflecting surface are denoted by Pyl-1, Py1-2., Py2-1 and Py2-2, respectively, the following condition is satisfied:

$0.5<Px2\text{-}1/Py2\text{-}1<2.0$ ....(4).

19. A finder optical system comprising:

said image-forming optical system according to claim [1] 25, said image-forming optical system being provided as a finder objective optical system;

an image-erecting optical system for erecting an object image formed by said finder objective optical system; and

an ocular optical system.

20. A camera apparatus comprising:

said finder optical system according to claim 19; and

an objective optical system for photography provided in parallel to said finder optical system.

21. An image pickup optical system comprising:

said image-forming optical system according to claim [1] 25; and

an image pickup device placed in an image plane formed by said image-forming optical system.

22. A camera apparatus comprising:

said image-forming optical system according to claim [1] 25, said image-forming optical system being provided as an objective optical system for photography; and

a finder optical system placed in one of an optical path separate from an optical path of said objective optical system for photography and an optical path split from the optical path of said objective optical system for photography.

23. An electronic camera apparatus comprising:

said image-forming optical system according to claim [1] 25;

an image pickup device placed in an image plane formed by said image-forming optical system;

a recording medium for recording image information received by said image pickup device; and

an image display device that receives image information from one of said recording medium and said image pickup device to form an image for observation.

24. An endoscope system comprising:

an observation system having said image-forming optical system according to claim [1] 25 and an image transmitting member for transmitting an image formed by said image-forming optical system along a longitudinal axis; and

an illumination system having an illuminating light source and an illuminating light transmitting member for transmitting illuminating light from said illuminating light source along said longitudinal axis.